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The Responsibilities of the Educated Engineer.

AN ADDRESS

DELIVERED BY

GEORGE S. MORISON,

CONSULTING ENGINEER AND PAST-PRESIDENT OF THE
AMERICAN SOCIETY OF CIVIL ENGINEERS,

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The Responsibilities of the Educated Engineer.

GEORGE S. MORISON. 7 842-1903

This University was created by the General Government of the United States, which set aside a portion of the public domain for its perpetual support. It is the special child of the State of Indiana which has accepted the conditions of the original grant and assumed the responsibilities attached thereto. As a University it holds the highest rank among the educational institutions of the State; it gives an education practically without cost to every young man or young woman who is ready to take advantage of it. This liberality, however, must not be looked upon as a charity; the State does not furnish this education for the benefit of the young men or young women who come here; their position is an intermediary one; it furnishes this education because it recognizes that it needs citizens educated in this way. Were it only for the good of the individual students such an endowment would be little better than a misappropriation of public funds.

Governments are assuming the duty of education. In old times this duty was only recognized in the form of a state religion and although the priests were the custodians of literature, science and art, as then understood, it was not their policy to disseminate educa-

tion widely. The importance of general education, especially in those countries which had free governments, was appreciated long ago. The substitution of mechanical for human power leaves more time for the average man to study and demands a higher order of intelligence in the man. The provision of an education has been assumed to be a proper function of government; it began with the free public school system which is now universal in our country and is extending around the world. The district school has passed into the graded school; secondary education has been taken up in the high school which every town must now have; the college or the university completes the system. This University is a noble example of this form of government work. This University, moreover, is one of the extreme modern type; not only are its schools especially devoted to the newer branches of education, teaching different departments of applied science, but it has extended its laboratory work to such a degree that it seems more like a factory than a school house; recognizing the dignity of labor, it would have its graduates capable of the higher orders of physical work as well as of the intellectual investigation of physical subjects.

As occupying a front rank among the educational institutions of the State, this University is charged with the responsibilities which this position implies. Three of its six departments are distinctly schools of engineering.

trains those who are to be the engineers of the next generation for the benefit of the community which has given it support. Furthermore, every one of you who takes advantage of the opportunities which this University gives, assumes the same responsibilities with which it is itself charged. It is dishonorable to take what is so freely given and use it for your own selfish benefit. To-day you leave here with the diplomas which place you among the Alumni of this University; the acceptance of these diplomas is a contract between your Alma Mater and yourselves; the consideration for that contract is the education which has been given to you; the obligation of that contract is that you devote your lives to the betterment of the State and country which this University represents.

In the broadest sense the duties of a university cover the entire range of education, both that education which studies and preserves the records of the past and that which trains the men who are to make the records of the future. The old universities were supposed to provide all the important courses of study, but their range of education was comparatively small; it was considered enough to teach what had been done in the past; no thought was taken of training men to enter the new fields of the future; they provided the old education, the new education was yet to come. The two great English Universities are to all English speaking people the representatives of the old

education. In America some of our oldest colleges have passed, as they developed, into universities devoted to the older education, finding it very hard to adapt themselves to the new. Others, generally of more recent origin, have included all branches and have done it with a success which calls for admiration. Some are like your own, devoted to science, technology, and agriculture, groups of schools or colleges, belonging entirely to the new education.

It was my lot to receive my education in one of the oldest colleges in the land, which more than a century ago began to call itself a university. It was, and perhaps still is, more nearly the representative of the old education than any other college in America; it is pre-eminently well qualified for this work. At its head when I went there was a man whose ability to grasp a subject in his own special line and to state it emphatically and effectively, was at least equal to that of any man I have ever met. His studies dealt with the mind; he knew little and thought little of physical science. He sought to distinguish man from the lower animals by attributes of the mind; man was to him the only creature who could make thought an object of thought; the lower animals observe and think of the physical objects which surround them, but this is the limit of their capacity; they cannot think of their own thoughts. No definition could be more typical of the old education and of the work of the older universities.

As engineers and as representatives of the new education we must seek something different, something more compatible with the lines of thought in which our minds are directed and the work which we have to do. Such a definition I venture to submit. Man is an animal who uses tools. How far this is a matter of mental or how far of physical capacity, we need not discuss; the lower animals can do nothing beyond the limits of their own bodies. It is the capacity to supplement his own powers by the use of tools which has given man his advantage over the beasts. The perfection and completeness of the tools which he uses is the measure of the degree of his civilization. The distinctive feature of a tool is that it is made for an ulterior purpose; it is valueless in itself; it is useful only to increase the power and capacities of its inventors and its users. Engine is but another name for tool. The tools of the present day include the steamship, the railroad, the telegraph and a multitude of other things without which modern civilization could not exist. The education which this University has given you has trained you to build and use such tools.

The two lines of education find a strange parallel in the extreme developments of the Aryan race to which we belong. The high caste Brahmin, dwelling in his own thoughts, has developed an acuteness of mind and a meta-physical refinement of ideas which are almost beyond our understanding. The

American engineer, using the most efficient tools and often caring too little for the past, is the modern man of action. They differ from each other more than either differs from the absolute savage who was their common ancestor; they have civilized apart; they are separated by an arithmetical sum instead of an arithmetical difference.

Those of you who to-day leave this University to begin your life work are entering on the responsibilities which you have assumed in accepting your education. In speaking to you, my purpose is to remind you of what some of these responsibilities are, of the work which you may be called on to do, and of some of the coming changes which may increase these responsibilities. In doing this I shall say less of the particular things which you may be expected to accomplish in the respective branches of your chosen professions, than of the general character of those duties, and the manner in which your responsibilities differ from those of people of different training with whom you may come in contact, from those of men who having been given less owe less to others.

And first I would remind you of the old definition which is embodied in the charter of the Institution of Civil Engineers: It is the business of the engineer to direct the Great Sources of Power in Nature for the Use and Convenience of Man. No other expression brings within so small a compass so full an idea of the objects and the responsibilities of

the life of an engineer. Creation, whether of substance or force, is beyond the power of man, he can simply direct the sources of power which already exist in nature. These sources of power are no greater or in any way different to-day from what they were when the first miserable man fashioned his first rude tool and used it to get the better of some wild animal. In those dark days these sources of power were unknown and undirected. In the lavish supply, which nature provides as bounteously for the feast which none attends as for the crowded banquet, they waited unused for a length of time which we have no means of measuring. They not only waited but much which would otherwise have been lost was preserved for the future, in the coal deposits and in the stores of oil and natural gas, the existence of which only the last half century has realized, and perhaps in other forms not yet understood. It is these sources of power which the engineer must direct; this direction is manufacture, it is not creation, but so far as mankind is concerned it has a similar effect. The work of the engineer adds to the wealth of those for whom it is done without taking anything from any one else; it is a generous work.] There is this distinction between the work of the engineer and the commercial operations of the merchant. Every properly designed tool adds its share to the comforts of mankind; it either gives him what he did not have before or it relieves him of labor required

to produce what he already had. The shrewd business man simply secures for himself, or for the interest which he represents, that which would otherwise have belonged to another; he adds nothing to the wealth of his race, he distributes it in a different way; his business is based on selfishness.

The manufacturer must sell his goods as well as make them; his work combines the duties of the engineer and of the merchant. If the spirit of the engineer predominates he seeks to better his plant, to perfect his tools, to equip himself so that it costs him less to make a better product, than it does any other producer of the same article. If, however, the commercial spirit is stronger than the engineer the disposal of his goods becomes the principal object; he seeks to undersell his rivals, to make immediate profits, thinking little of permanent results. This difference may be seen in manufactures, in transportation lines and in every one of those special callings which civilized life has developed. The mercantile spirit produces quick returns and early profits; work done in the engineering spirit takes time, its best results come slowly.

✓ The work of the engineer is to be for the use and convenience of man. It has been said that whoever makes two blades of grass grow where one grew before is a benefactor of his race. This thought must not be forgotten, the powers of nature are to be directed for use and convenience; the right minded en-

gineer must recognize that his achievements belong to the whole community rather than to himself. A distinguished English engineer, perhaps the most brilliant and accomplished of his time, considered it unprofessional to protect any of his devices by patents; whatever he did was open, free to be copied by all. I mention this, not because a course so radically different from that pursued by many good men, is the wisest or the best, but to show a kind of spirit which we recognize as noble. As engineers you may take salaried positions; you may practice for fees as in any other profession; you may become manufacturers or contractors; whichever course you may take you will find a life in which you can be governed by the highest ideals and can do real good to your race; whatever course you select, do not let the selfish commercial idea bury the generous engineer; you owe this to the State which has given you your education to work for the community rather than for yourself.

There is a spirit that should actuate you in all that you do; if you enter earnestly into the design of the works which are to utilize the powers of nature or the execution of the plans involved in those designs, the more complicated you find the work, the more difficult you find its execution, the greater should be your interest in it, the greater should be your love for it. Education obtained against the will and with no interest in study is of little value; work in which the worker takes no interest is never

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well done. The responsibilities of your education call on you to enter thoroughly into the spirit of the work for which it has trained you, to care more for excellence than for profit; in brief, to love your work; unless you do so it will not be your best work. This spirit has characterized the best students, the best investigators, the best men in all ages; through the great developments of the last century, it has characterized all the best engineers. There is, moreover, another quality which should belong to the educated engineer; the greatest engineer is not the man that knows the most, but the man who when confronted with a new subject can best grasp the novel problem and whose judgment is most likely to be correct; he must not only understand the special laws and subjects of his own department, but he must keep his mind in such condition that he can apply himself to new problems which may arise at any time. There are very competent specialists, to whom the solution of a problem in a way for which they have no precedent is impossible

The training which you have received at this University is largely a training in specialties. It is not, however, a special training without some foundation of liberal education. As members of a great profession in whatever branch you practice you should not allow your professional work to shut you out from respect, an appreciation and a general understanding of the work of other men in diff

ent lines, in different professions and even in the occupations which are given no professional name. The active American engineer should respect even the mild, meditative Hindoo.


Your work, however, may not be confined to what is commonly understood as engineering. Many a man beginning as an engineer graduates from that profession and goes into other work in which, though perhaps less technical skill is required, the advantages of a technical training never cease to be felt. The management of corporations and many branches of Government work are of this kind.

The great corporation is a modern development which many people fear. It has become so great that its powers are thought to threaten the freedom of personal independence and to endanger the purity of governments. These are real dangers, but the great corporation exists and modern civilization cannot do without it. We do not condemn the steam-engine because a boiler sometimes explodes; we hail with satisfaction electric transmission, although the high tension current sometimes kills. The conscientious engineer takes care that no unnecessary dangers attend his work. The manager of a soulless corporation, has a soul himself; he can keep the record of that corporation clean and make it a blessing to a great community. You can be called to no higher duty than such management; you can assume no greater responsibilities.

Large aggregations of capital have become necessary. In no other way can the tools and appliances necessary to develop economical results be obtained. This aggregation of capital means one of two things; it means either the concentration of great wealth in the hands of individuals or it means the collection of the wealth of many in great corporations. The two are gradually becoming combined; individual manufacturers are availing themselves of legal provisions to place their affairs under the protection of corporate ownership; there is nothing to prevent the concentration of the greater part of the stock of a corporation in the hands of a few men or even a single individual. This tendency results in a concentration of control and management, rather than in a real unity of ownership. However great the wealth of individuals and the amount of property concentrated in a few hands, the wealth of these individuals may be much less in the aggregate than the savings and small capital of the people of small or moderate means, and when these people are working for wages, as nearly all of them are, they have no use for their savings or small capital. This small capital, though the owner may not understand what really becomes of it, is used by the corporations and by the wealthy men who are carrying on the great manufacturing, transportation and other active works of the country. The capital of the nominal owners and the nominal capital of corporations is

generally very much less than is required to conduct their business. The other money is borrowed; borrowed from small investors, from savings banks and from other financial institutions; borrowed at rates of interest which are low in proportion as the security is large. All this borrowed money has a claim on the capital of the corporation and on the wealth of the individual manufacturer before any profits can be distributed. The apparent owners may take the larger profits but they assume the risks; the ultimate ownership is with the owners of the borrowed money, who must always be protected, even at the entire loss of every other interest.

Theoretically it would seem that the ideal method of concentrating capital would be by co-operation, so that the small capitalists and the operatives might be the actual and responsible owners entitled to divide among themselves the profits of the enterprise. It is possible that some method of accomplishing this result will ultimately be worked out; if it has been done successfully heretofore, it has only been on such rare occasions that they have little influence on the general conduct of affairs. But though apparent co-operative ownership may not exist, real co-operation does; it exists through the agencies of savings banks and other similar organizations which receive as deposits the savings of the workers and lend them out to swell the capitals of the producing organizations; it exists in the system of preferred se-



curities, as in the case of railroad and other corporate bonds which are entitled to their interest as an absolute charge, or in the case of preferred stocks which are entitled to their dividends before any profits can go to the common stockholders. The results are very far from perfect and have by no means reached their full development, but the real ownership is much more widely distributed than the workers generally know.

Every manufacturing plant is a tool, it has no value except in its capacity to produce. It was the general characteristic of the merchant, from the earliest times, to keep his knowledge secret and to make the best bargain he could. Modern conditions render this impossible; there will soon be no secrets of trade by which profits can be made; knowledge of what is going on anywhere in the world is even now open to all and any one who desires to do so can learn any specific thing. Profits must be made, not by buying cheap and selling dear, but by reducing the cost of production. The work of the manager is to handle his tools, it is to manufacture rather than to trade. While the products must be sold, the greatest skill must be shown in getting the largest results which the tools are capable of. The most successful manufacturer will not be the one who has the shrewdest salesmen to dispose of his goods, but the one who can manufacture his wares more cheaply and at the same time better than any one else engaged

in the same work. The most successful transportation line will not be the one whose agents are most active in securing business, but the one which is the most closely handled, which can carry its freight at a less cost to itself than any competing line. Permanent success will depend not on commercial drummers but on the intelligent engineer; not on the shrewd guesses of the so-called business man, but on the accurate knowledge of the manager who knows what his tools are, who knows what it costs to produce, who knows the defects of his plant and the features in which it may be improved, who in fact is applying all the intelligence of an educated man, not selfishly to getting the better of some other man who may know a little less, but generously to getting the best work possible for himself and his employers out of what he has to work with.

As these tools become larger and the demands upon them greater, the responsibility and honor which belongs to the successful management of such interests will be more fully recognized. No regret need be felt for the passage of the sharp mercantile spirit. Careful and skilled management are a nobler type of work. The century opens as an era of corporations and the relations between the ownership and management of corporations are gradually being fixed. The old rule of equity, that any one handling the property of another is a trustee and has no right to use that property for his own benefit, is funda-

mental and must always govern the management of corporations. In a corporation there are three elements at work; ownership, employees, management. The ownership includes not only the nominal owners but all the ultimate owners, many of whom are often employees. The employees are mechanics and laborers who handle the machines and do the comparatively small amount of manual labor which machinery has not yet mastered. The manager is the trustee for both parties; he must understand the tools that he uses and get the best work out of them that he can for the owners; he must understand the relations between those tools and the men that work them and see that the workmen are competent and cared for. The rights of ownership are the rights of property which are the foundation of all civilized governments; the manager is the trustee for this ownership. The rights of the employees are the rights of men and women who are profiting and must be allowed to profit by the developments which the modern tool has rendered possible, and to whom the increased leisure and comfort which the substitution of mechanical power has given us, must ultimately accrue. The owners and workers both have rights; the managers have principally responsibilities.

The necessary aggregations of capital and the necessary extensions of corporate ownership and management, have another important effect which many may deplore, but

which is inevitable. No change is without its losses. The passage of a race from one civilization to another, involves the loss of some of the best features of the older life, leaving a void, while the new conditions, with their new virtues, are being developed. The new condition must reduce the number of people who work by themselves, it must reduce the number of men who seem to be entirely their own masters and who pursue their lives on independent lines; it must increase the number of salaried employees, the number of men who are working for fixed wages and who are apparently dependent on others. Its development will wipe out the small manufacturers, they cannot compete against the great concerns; it must wipe out many of the small traders and dealers whose business has always been that of middle men. In fact these changes make men members of communities, members of working organizations, members of what has been called an army of workers, but necessarily deprive them of many of the conditions which have hitherto done most to produce strong individual characters. Were this all it certainly would be an evil. The loss of independence is a great loss, it is always regarded with regret. Whatever his vices and wickedness, and they have been enormous, there is a noble element about the life of the savage, which will live in literature and song, long after his sins are forgotten. The strong features of American pioneer life, with its

combination of manual labor and high intelligence, which bred the men who fought the Revolution, calls for the highest admiration and praise, in spite of the physical pain and suffering which wore out so many of these people before they had passed middle life. But no one would voluntarily go back to the conditions under which our grandparents were born, still less would he adopt the life of the noble savage. It is premature to say where the compensation for the loss of individualism and personal independence will be found. It may be in a good use of the greater amount of leisure which all men will have when human labor is reduced as that of the machine increases. It may be that it will be found in the higher degree of skill and education which must characterize in these days of machinery all classes of labor. It may be that it will come from the satisfaction which attends the immolation of the individual in the whole, till he recognizes as his own a share in what every one else is doing. Whatever form this compensation may take we may be sure that it will come; it may be only after a severe struggle; but the laws which control the development of the new civilization are inevitable and supreme. As engineers and managers you can help on the future good of our race by utilizing and improving the new conditions, you cannot do it by trying to retain the good features of conditions which are passing away.

I once knew a man, of singularly attract-

ive personality, who beginning as a civil engineer, nominally gave up that profession but really passed into one of the higher ranks of which it is capable and became a railroad superintendent and ultimately the president of a great railroad system. Throughout his career he retained the gentleness of his youth and the enthusiasm of his early manhood. In speaking of professional work and what I myself was doing, which was in the nature of general practice, he said that it lacked the satisfaction which belonged to watching and directing the development of a single great property. Like the emancipated slaves in the old Greek army, who being without a country, adopted valor and courage for their fatherland, so he, a childless man, adopted his work and loved it. He was not working for his salary but in the satisfaction of seeing the great interests which were intrusted to him, develop and expand. It was the true spirit which should actuate the engineer, the kindly noble spirit which can make a great corporation a blessing to the community which it serves.

You are citizens of a republic. This means that you have a responsible share in the government. You cannot hide this responsibility behind the loyalty of a subject. It is one of your first duties to understand the government which you not only live under but are responsible for. Had I the say about it, I would never give a degree to anyone who could not repeat the Constitution of the United States, and I

would make this requirement as absolute for a scientific degree as for one in literature or even in law.

There must be a great increase in the variety of the duties of governments; there will be a great extension of the geographical limits over which a single government can exercise immediate and direct control.

In early days the functions of governments were but two; the protection of the people against foreign enemies, which meant the conduct of war; and the protection of the people from domestic enemies, which meant police and the whole system of both criminal and civil law.

One of the first departures from the old limits of government was the post office, whose introduction dates back only two or three centuries, and whose general extensions to communication with all parts of the world for the benefit of every member of the community is of very recent date. It seems hard to recognize that there were no mails in the Roman Empire and that even to this day there is no general government mail service in the Empire of China. In ancient times the young wife who followed her husband to a distant colony, whether to one of the Greek colonies on the Mediterranean or at a later date to the outposts which Rome scattered much farther, bade farewell for life to all her friends and relations from whom she might never hear again; the change of old friends and surroundings for

new ones was absolute and complete. To-day a European emigrant who settles in America, in Australia or in southern Africa, is in constant communication with the home from which he came and this constant communication, at once keeping up the friendships of the old and gradually bringing them into contact with the friendships of the new dwelling place, must have great influence in unifying and consolidating relations which are of much more than personal character.

Another duty of governments, not wholly new, but yet distinctive of our time is that of sanitation; something of this kind has been done in cities for an indefinite period; it was especially marked in the days of Rome, where the sewer built in the time of the Tarquins still carries the drainage of the eternal city to the Tiber, and where aqueducts built in the days of the emperors, still supply better water than is found in many cities. But with increased knowledge and capacity, the duties of the government in caring for the health of the people have become very greatly increased. Water supply is not confined to the more important cities, but is extending to small towns. Water supply must always be followed by sewerage and the modern sewerage system must not only take away the sewage but dispose of it and utilize it. Other duties follow; they are being assumed, perhaps, too rapidly. Lighting public ways is a duty of cities and it may be that the supply of light and heat for

private consumers may soon be considered a government duty. These are duties of which you have especially accepted the responsibility.

The possibility of geographical extensions of governments is even greater than of the additions of new functions. It is absolutely essential to a satisfactory government that no long interval should elapse between the need of action and the action itself, between the issuance of instructions and the execution of such instructions. Various methods have been adopted to overcome this difficulty. The delegation of power to viceroys and others was the method in use in the empires of old and in Asia to-day; representation came later and was the only method by which a single popular government could be extended over any considerable area of country. The Constitution of the United States is the most perfect device ever made for the extension of a government by the people over a great area of country. But since its adoption distance has been annihilated. With the present condition of steam navigation there is no seaport in the world which cannot be reached from any other seaport in about thirty days; it may not be done by any regular line of transportation, but it could be done in an emergency by the use of special ships. Railroads have brought every place in the United States except Alaska within less than one week of every other place. The combination of steamship and railroad services may, within another

century, make it possible to go from every place to any other place on the planet in about three weeks. The telegraph goes beyond this and it is now, not only possible, but actual practice, to know in every civilized city on the earth what has taken place on the preceding day in every other city. A very recent invention makes it probable that within a decade the human voice will be transmitted instantly to every part of the globe. These changes have removed the conditions which formerly limited governments. If a single government could be organized to handle the affairs of the entire earth and give equal rights and like laws to all races and conditions of men, the physical difficulties in enforcing the acts of such government would be much less than those of handling the thirteen states at the time of the adoption of our Constitution.

Whether such universal government will ever exist is a question with which we have nothing to do. So far as physical conditions are concerned, the engineer will make it possible; whether it ever will be and whether it would be desirable for it to be, are different things. It seems more probable that the increased respect which different nations will have for each other as they come to know each other better, as each one learns to adopt the better features of others and to discard its own worst features, may lead to the existence of a few great nations which will manage their own affairs separately but which

will bear to each other relations like those which exist in a peaceful family.

At present the obstacles to the unification of the human race are great; they are an inheritance from the past which the engineer must gradually obliterate. The mental and intellectual obstacles will be much more difficult to surmount than the purely physical obstacles, but if they ever are surmounted the conquest will be complete, while the mountains and oceans will continue lines of past demarkation overcome by the work of the engineer but still remaining to help understand the history of the ages which are just entering their final period.

It is unwise to predict too much but we may be sure that the effect of time will be to reduce greatly the number of nations in the world; that these nations will ultimately be large but compact, perhaps not more than a dozen in all; that the duties and responsibilities of government will increase and that there will be great changes in the forms of government. The world has been ruled successively by the soldier, the priest and the lawyer. Prowess and statecraft have governed and often governed well. We look to a government of the people by the people, in which the governed are not the subjects of the governors, but the governors are the servants of the governed. Such a government will for the present need the soldier; for many centuries it will need the jurist; it will always

need in many of its most responsible positions, the man, who whether he be called an engineer or by some other name, is devoting his skill and energy to bettering the conditions of his fellow citizens by directing and controlling the great powers with which nature has surrounded them for the use and convenience of the people whose servant he is.

There is a strange story of a prophet, who after weird adventures and tribulations of strange and terrible character, such as have befallen no other man, at length reached the great city which he had been trying to avoid, preached its destruction in no measured terms, and then complained when one mightier and wiser than he, accepted repentance instead of destruction. Your duty as engineers and as citizens is not to repent, but to direct for use and convenience the powers and conditions whose superiority justifies the destruction of even the best that stands in their way. Little good is done by the man who only weeps and criticizes. You will help to destroy the conditions which gave most interest to the history of the past and many of the traditions which people hold most dear. Savage and barbarous races must either be elevated to the life of their more civilized contemporaries or they must vanish. The entire world must be educated and one of the greatest dangers will come from this very source, when the number of half educated people is greatest, when the world is full of people who do not know

enough to recognize their limitations but know too much to follow loyally the direction of better qualified leaders. With the disappearance of ignorance will come the destruction of superstitions which have exercised such a momentous influence in the past, perhaps generally for evil but in many instances for good. There must be a great destruction both in the physical and in the intellectual world, of old buildings, old boundaries and old monuments and furthermore of customs and ideas, systems of thought and methods of education. There must be destruction of old constitutions; destruction of races as they merge into one another; destruction of languages, in the gradual disappearance of all but a few of the most important, while even these in times may give place to one that is universal. It is not worth while to consider how this destruction will occur nor how much time it will require for its completion. The important fact is that destruction will come, not because the things which are destroyed are in themselves bad, but because however good and useful they may have been in the past, they are not adapted to the needs of the time.

Our principal thought must not be of the destruction but of the new development which makes that destruction necessary. But destruction is always attended with danger; time may elapse after the old has gone before the new is established. Education is adapting itself to the new demands. There will be many other

changes the general nature of a few of which has already been outlined. The danger is that the destructive changes will come too fast and the developments which are to take their place, not fast enough. The trouble will lie in the possible gap between the two. Here is one of the great responsibilities of the educated engineer.

When the period of change is over it would seem as if the final conditions of human civilization would have been reached. It is proper to say that it seems, for no one can tell what capacity may at some future time change the conditions of life again. But when the development has become universal over the whole globe, so that all will have the same tools to work with and if necessary to defend and fight with, so that each land has the advantage of what all the others know, when the possibilities of adventure are removed, when the opportunities for speculation no longer exist, when the pioneer becomes impossible, mankind may settle down to a long period of rest.

It seems likely that material developments will come to a gradual pause, that the stimulus will be removed and that the densely populated earth may continue for centuries with comparatively little change; that an immense population will live comfortably and happily, and that the qualities which make the good citizen and the contented man will be more in demand than those which make pioneers and

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leaders in such periods as we are familiar with. There may be a time when every one will understand the comfort and peace of mind which attend the adaptation of personal feeling to the general environment. However satisfactory this condition may be, whatever its delights and whatever the excellence and happiness which may be in store for the inhabitants of the thirtieth century, they are not for us. We have, however, one privilege which will not belong to them. In all history and in all periods of the world, the honors are held to belong, not to those who enjoy the results, but to those who have made these results possible. You, who are entering the world as the engineers of the twentieth century have the privilege of doing your full share in bringing forth the great changes which future generations may profit by. You have the privilege and the greater the privilege the greater are your responsibilities.

Our country has had unusual blessings. In its earliest days, in the weakness of infancy, in the period when new nations are apt to fall under the control of ambitious and designing leaders, the one man who could have been such a leader, was one whose patriotism forbade it; he wished to see the republic established on a permanent basis, nothing could have persuaded him to found a dynasty as others might have done. In the next great period of national trial we had a leader, who though in early training and in personal habits

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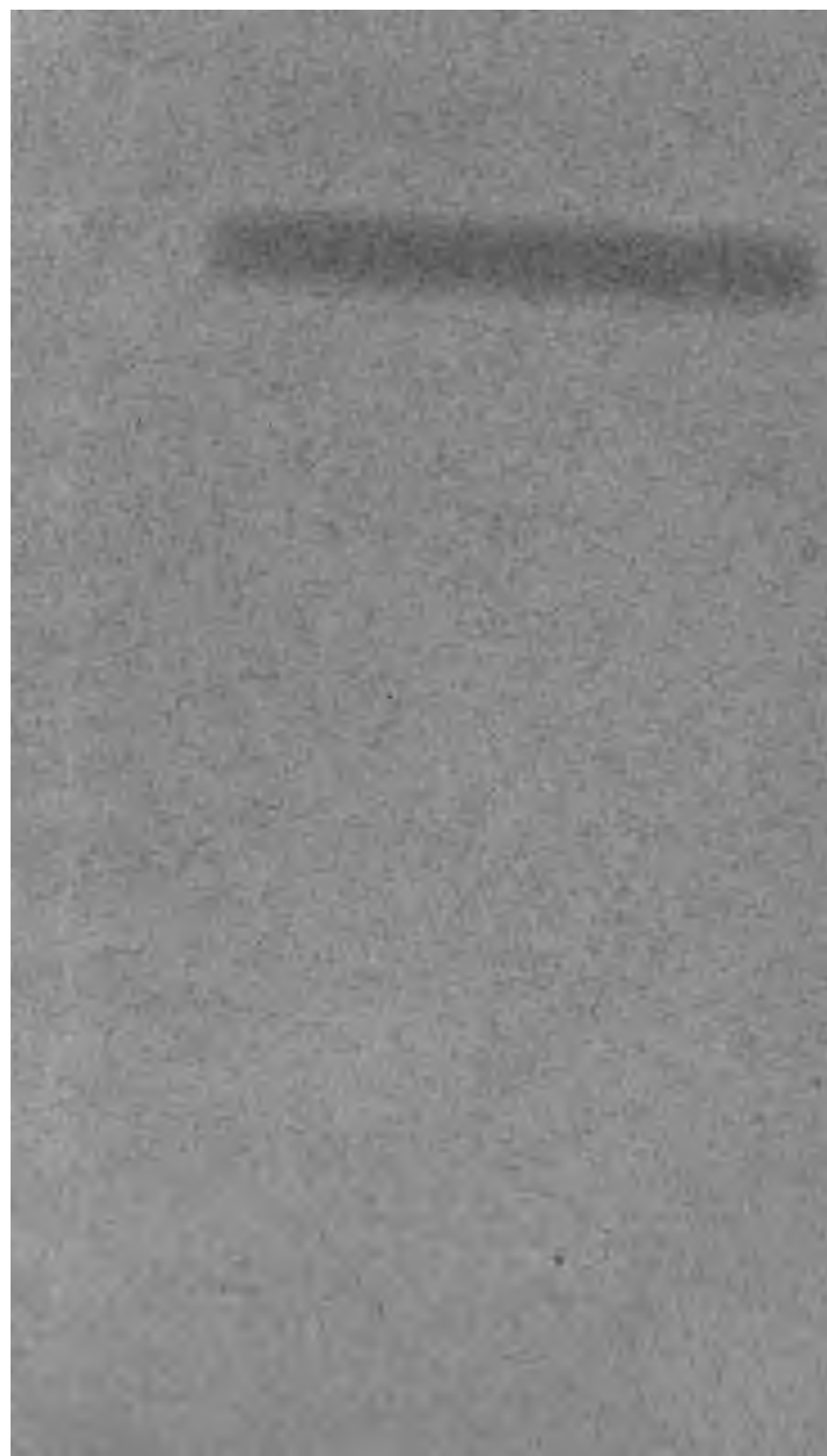
absolutely unlike his great predecessor, was as free as any man who has ever lived from any thought inconsistent with the truest patriotism. It is to the noble unselfishness of these two men that we owe the existence of our great republic to-day.

Another change is upon us, not one to be determined by the gage of war, but one which requires no less the unselfish patriotic spirit. From being a small and poor country we have become one of the greatest and the most wealthy nation in the world. From being a land of small producers where the means of everyone were limited, we have become a nation in which great fortunes are common and where the advantages of wealth are often too highly valued. It is a good sign that many of our richest men are using their wealth less for the benefit of their descendants than for the general endowment of the community at large. This is good as far as it goes, but it is only a small part of what is really needed. We need the generosity of the true engineer; we need the integrity of the trustee; we need the self sacrifice of the patriot. The only thing which can protect us against the dangers of our wealth, is a spirit which appreciates the responsibilities which you assume as members of a family, as members of a community, as citizens of the State which has educated you, as citizens of the country which has made this education possible.

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